

REMARKS/ARGUMENTS

Reconsideration is respectfully requested of the Final Office Action of December 20, 2005, relating to the above-identified application and entry of the foregoing amendment after final is respectfully requested for the purpose of placing the application in condition for allowance, or alternatively in better condition for appeal.

A one month extension of time, together with the associated fee, is filed herewith.

Applicants note with appreciation that the Official Action indicates that Claims 2, 7, 8 and 10 contain allowable subject matter. Claim 9 is proposed to be amended to include the proper Markush language which was inadvertently omitted from the previous amendment.

Applicants also wish to acknowledge the brief telephonic interview with the Examiner on March 23, 2006 for the purpose of making the distinction between “chelating agents” and “metal chelate complexes”, which distinction will be discussed below.

Claims 1, 3-6, 9 and 11-13 stand rejected under 35 U.S.C. § 103 and applicants respectfully request reconsideration. The Official Action relies on the British patent of *Davies* (GB 1,090,294), taken with *Clough* (US 5,279,803). Applicants respectfully submit that the references fail to establish *prima facie* obviousness of the claimed invention.

Briefly summarized, the invention as set forth in Claim 1 of the original application is directed to a process for the regeneration of a supported or unsupported suspension catalyst containing at least one platinum group metal. The process is carried out by dissolution of the platinum group metals present in the catalyst in an aqueous hydrochloric acid. An oxidizing agent is used for the platinum group metals and this is followed by filtration of insoluble constituents and precipitation of the platinum group metals by means of a reducing agent at a pH

in the range of 2-10. An important feature of the invention resides in carrying out the precipitation step in the presence of a chelating agent for one or more metals selected from the group consisting of group 2a, 3a, and 4a of the Periodic System and Transition Elements.

It is important to establish at the outset a clear and unambiguous distinction between the terms "chelating agent" as used in this application and the term "metal chelate complex" as used in the cited prior art document to properly construe pending Claim 1. The term "chelating agent" must be given its plain and ordinary meaning. Please find enclosed three dictionary entries (Wikipedia, dictionary.com and MSN Encarta) which all prove that the term "chelating agent" refers to a compound which combines with a metal to form a chelate. The resulting chelate is called a metal complex. Therefore, there can be no doubt that a skilled person will understand the term "chelating agent" in Claim 1 as referring to a metal-free ligand and not to a metal complex (the chelate).

The Official Action alleges that *Davies* discloses a process for the recovery of at least one platinum group metal, such as palladium, platinum or gold from catalysts which are supported in finely divided form on a carrier. The *Davies* process as described in the Official Action is carried out by treating the catalyst in an aqueous medium of HCl and hydrogen peroxide, in the presence of an oxidizing agent. *Davies* also discloses carrying out a filtration step and a precipitation step of the platinum group metals. The reducing agent used is formed of formaldehyde. The Official Action admits that *Davies* does not disclose utilizing the reducing agent at a pH in the range of 2 to 10 in the presence of a chelating agent.

The Official Action relies on *Clough* for disclosure of a process for recovering precious metals such as platinum group metals. According to the Final Action, page 3, second paragraph:

“*Clough* continues to teach wherein the recovery of the metal is carried out using a chelating agent along with a transition metal, wherein the pH can be maintained within the range of from 1-10.” The chelating agent, according to the Official Action, can be citric acid, tartaric acid, as well as nitrilotriacetic acids.

The Final Action concludes, at the bottom of page 3, that it would have been obvious to utilize a chelating agent during the precipitation step of *Davies* allegedly because *Clough* teaches a process for recovering precious metals such as the platinum group metals where the recovery of the metal is carried out using a chelating agent along with a transition metal and where the pH may be maintained within the range of 1 to 10.

The Final Action further contends that the modification would have been obvious because one of ordinary skill in the art would have expected a process for recovering platinum group metals as taught by *Clough* to have been similarly useful and applicable to a process for recovering platinum group metals as shown by *Davies*, see page 4.

However, applicants respectfully submit that the disclosure of *Clough* has not been properly construed.

There is no disclosure in *Clough* of using a chelating agent, i.e. a metal-free compound for precious metal recovery. *Clough* teaches a process for recovering precious metals from carbonaceous ores with at least one added metal component in an amount effective to at least promote the oxidation of the carbonaceous material (col. 1, lines 55-60; Claim 1).

Clough further teaches that the metal component can be a complex of iron, copper, cobalt, vanadium or manganese with ligands (col. 4, lines 30-39) and such complexes are complexes with chelating ligands (col. 4, line 40 to col. 5, line 2).

Clough also teaches that not all of the metal has to be complexed, but some of the metal can be non-complexed (col. 5, lines 16 to 32) as is apparent from the preferred metal to ligand ratios (col. 5, lines 25 to 32).

All this disclosure is related to metal complexes. There is no disclosure or suggestion of a recovery process carried out with a chelating agent, i.e. a metal free compound. The metal complexes disclosed by *Clough* are chemical compounds formed by a reaction of metals with ligands and not merely mixtures of a chelating agent and a transition metal as alleged in the Final Action.

It is further to be noted that *Clough* only teaches the usefulness of metal complexes for pretreating a carbonaceous ore, but does not disclose or suggest that a benefit could be obtained by the presence of such metal complex in the subsequent processing steps of dissolving the platinum group metal and precipitating the platinum group metal. *Clough* clearly teaches that the benefits of using the metal complexes are obtained when the steps of dissolving the platinum group metal and precipitating the platinum group metal are carried out in the absence of the metal complex (col. 10, lines 37-61) and the preferred embodiment is directed to such process, where dissolving of the platinum group metal and precipitating the platinum group metal is carried out in the absence of the metal chelate (col. 11, line 13 - col. 12, line 19). Therefore, *Clough* would not motivate a skilled person to use the disclosed metal

complexes on anything else but a carbonaceous ore as a pretreatment. A skilled person also would not be motivated to use the metal complex in a processing step after solid material has been removed, because he would not expect them to have any useful effect in such step based on the teachings of *Clough*.

Still further, applicants submit that a skilled person would not consider employing the metal compounds of *Clough* in the dissolution step of *Davies* based on common knowledge of the decomposing action of transition metals on hydrogen peroxide. It is common knowledge that iron, copper and manganese ions are strong catalysts for decomposing hydrogen peroxide. (Ullmann's Encyclopedia of Industrial Chemistry 5th Ed., Vol. A13, pages 446-447 enclosed). Therefore a skilled person would not consider adding compounds of these metals to the process of *Davies* where hydrogen peroxide is a reagent, because he would expect them to have a detrimental effect due to hydrogen peroxide decomposition.

It is of particular importance to note that the *Clough* process is related to a distinctly different technology from that presented in the present application. Applicants' process relates to the regeneration of a suspension catalyst containing a platinum group metal. The *Clough* invention relates to a process for recovering precious metals from an ore containing carbonaceous materials. See the Abstract on page 1 of the patent. As pointed out in col. 1, beginning at line 28, carbonaceous ores contain elemental carbon such as graphite or organic compounds and it is the presence of the carbon and organic compounds that makes it difficult and expensive to recover valuable metals such as the precious metals.

In order to present a process which is said to be an advance over prior methods for recovering of precious metals from carbonaceous ores, *Clough* suggests contacting the ore with

at least one added metal component in an amount defective to promote oxidation of the carbonaceous material. See col. 1, lines 55-66. The conditions necessary to carry out the *Clough* process include chemically oxidizing at least a portion of the carbonaceous materials and then at least partially liberating the metal to be recovered from the ore. The second step involves actual recovering of the precious metals.

Note that when *Clough* uses the term “at least partially liberate the metal to be recovered from the ore”, he means to place the precious material in the ore in a condition which is more susceptible to recovery, for example, by cyanidation, than without the pretreatment. Thus, *Clough* does not “liberate” the precious metal by dissolving the precious metal, but instead makes the precious metal more accessible to a subsequent dissolving step. For example, *Clough* discloses that in one embodiment, the contacting of the carbonaceous ore can be with a gaseous source of oxygen such as air or oxygen. See col. 1, beginning at line 67.

Clough discloses that an improved rate of oxidation including solubilization or conversion to a different form, for example, solids, accomplishes an improved rate of oxidation of the carbonaceous material and the yield/recovery of the desired metal as the function of time is substantial. See col. 2, lines 30-37.

The reference further teaches that the process as described therein is intended as an improvement over the previous chlorination/oxidation procedures which require a substantial amount of chemicals and other expensive technology.

Clearly, the combination of *Clough* with *Davies* would not motivate a person skilled in the art to (1) replace the metal chelate complex of *Clough* from the carbonaceous pretreating step, (2) select instead a chelating agent and (3) add the chelating agent to the *Davies* recovery

procedure. Thus, at least three distinct steps would be necessary to modify the *Davies* process. There is nothing in either reference that leads a person skilled in the art to replacing a metal chelate complex in a pretreated step by a chelating agent in a recovery step with the expectation of a successful result.

Clough discloses as an example of the specific conditions of the invention, the use of iron, copper or cobalt with a chelating agent as shown in col. 4, lines 30-68. In these metal complexes, all the ligand is bound to the metal, as becomes apparent from the metal to ligand mole ratios of from 1 to 3 disclosed in col. 5, lines 25-32. There is no suggestion in the *Clough* reference to use a ligand that is not complexed to a metal.

A person skilled in the art would understand that a chelating agent is a compound that is capable of binding to a metal forming a polydentate metal complex. See the attached definitions of “chelating agent” from Wikipedia, dictionary.com and MSN Encarta. Thus, the metal complexes of *Clough* are not encompassed by the art recognized definition of chelating agents because they already contain a metal and, therefore, are not capable of binding further amounts of metal.

Furthermore, even if a skilled person would combine the *Clough* reference with the *Davies* reference as suggested in the Final Action using one of the metal complexes as disclosed by *Clough* as an additive in the *Davies* process, it would still not arrive at the claimed subject matter since the metal complexes of *Clough* are not chelating agents as defined in the application that are capable of complexing any further metal. Note that applicants’ claims herein specify that the precipitation is carried out in the presence of the chelating agent for one or more metals

from the indicated members of the Periodic System. The metal complexes of *Clough* do not meet that qualification.

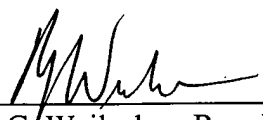
The secondary reference of *Clough* teaches that the metal contained in the metal complex is an essential element of the process. Consequently, a person skilled in the art would not consider using a metal free ligand in place of the metal complex based on the teachings of *Clough*.

In view of the foregoing, applicants respectfully submit the rejection of the claims is improper as it does not establish that the subject matter claimed herein is *prima facie* obvious in view of the combination of references relied on by the Examiner.

Favorable action at the Examiner's earliest convenience is respectfully requested.

Respectfully submitted,

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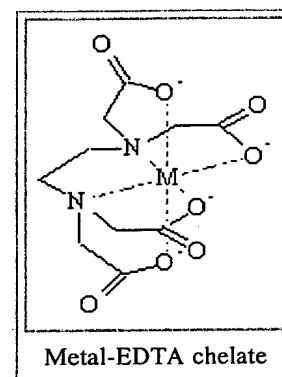
Chelation

From Wikipedia, the free encyclopedia
(Redirected from Chelating agent)

Chelation (from Greek *χηλή*, *chelè*, meaning claw) is the process of reversible binding of a ligand, the **chelator** or **chelating agent**, to a metal ion, forming a metal complex, the **chelate**.

Chelators are used in chemical analysis, as water softeners, as preservatives, and in medicine (chelation therapy), where they are employed to safely bind with poisonous metal agents such as mercury, arsenic, or lead in order to stabilize them and allow them to be excreted without further interaction with the body. Natural chelators include the porphyrin rings in hemoglobin or chlorophyll and the Fe^{3+} chelating siderophores secreted by microorganisms, and are contained in herbs such as cilantro, which has long been used as a treatment for heavy metal poisoning. A commonly used synthetic chelator is EDTA.

A chelator does not have to be organic. In contrast to the simple monodentate ligands like H_2O or NH_3 , which are easily broken apart by other chemical processes, the polydentate chelators form multiple bonds with the metal ion, resulting in more stable complexes.



Metal complexes are of widespread interest and studied by inorganic chemists, physical and organic chemists, biochemists, pharmacologists, molecular biologists, and environmentalists.

Antibiotic drugs of the tetracycline family are also chelators of Ca^{2+} and Mg^{2+} ions and are incorporated into bones and teeth.

In ecology chelation compounds are related to the mobilization of metals in the soil, the uptake and the accumulation of metals into plants and micro-organisms and as a mechanism for resistance and hyperaccumulation adaptations. Such chelation of heavy metals can be used in bioremediation.^[1]
(http://en.wikipedia.org/wiki/Chelation#endnote_ecology)

The term *chelate* was first applied in 1920 by Sir Gilbert T. Morgan and H. D. K. Drew in J. Chem. Soc., 1920, 117, 1456, who stated: "The adjective chelate, derived from the great claw or *chele* (Greek) of the lobster or other crustaceans, is suggested for the caliperlike groups which function as two associating units and fasten to the central atom so as to produce heterocyclic rings."

See also

- Bioremediation
- Chelation therapy
- Electron counting
- Organometallic chemistry

References cited

1. ^ Prasad (ed). Metals in the Environment. University of Hyderabad. Dekker, New York, 2001

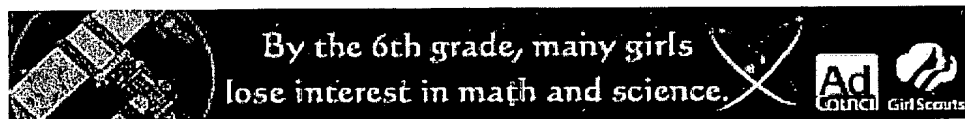
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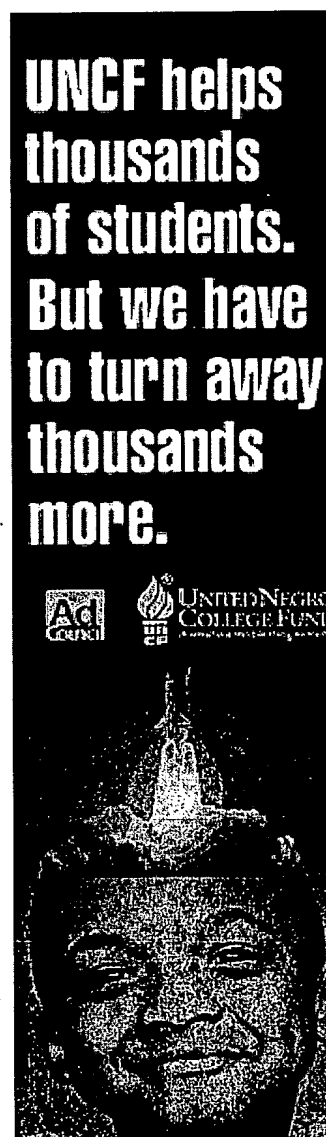
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Pronunciation: 'kE-"lA-ti[ng]-

Function: *noun*

: any of various compounds that combine with metals to form chelates and that include some used medically in the treatment of metal poisoning (as by lead)

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che·lat·ing a·gent (*plural* che·lat·ing a·gents)

noun

Definitions:

substance that forms a chelate: a chemical that combines with a metal to form a chelate. Use: treatment of metal poisoning.

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Hydrogen Peroxide

Peroxo Compounds, Inorganic and Peroxy Compounds, Organic are separate keywords.

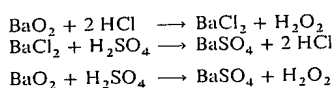
GUSTAAF GOOR, WOLFGANG KUNKEL (Chaps. 1–7), OTTO WEIBERG (Chap. 8), Degussa AG, Hanau, Federal Republic of Germany

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1. Introduction and Historical Aspects

The industrial production of hydrogen peroxide passed through three phases, starting with wet chemical processes, followed by electrochemical processes, and then by organic autoxidation processes. Almost all hydrogen peroxide is now produced by organic autoxidation (AO) processes, primarily the anthraquinone process.

Wet Chemical Processes. In 1818, L. J. THENARD [9] obtained hydrogen peroxide for the first time by reacting barium peroxide [1302-29-6] with nitric acid. This process was improved by using hydrochloric acid to release hydrogen peroxide. The water-soluble barium chloride which is formed simultaneously, was precipitated with sulfuric acid.



With this reaction, THENARD established the foundation for the commercial manufacture of aqueous hydrogen peroxide solutions based on wet chemical processes, which began around 1880.

Industrial plants using the barium peroxide process were still operating until the middle of this century. Around 1900, approximately 10 000 t/a of barium peroxide was processed by this technology, yielding ca. 2000 t of hydrogen peroxide per year. Sales opportunities for the co-product barium sulfate (BaSO_4 , blanc fixe) had a decisive effect on the profitability of the process.

The 3% aqueous hydrogen peroxide solutions manufactured by the barium peroxide pro-

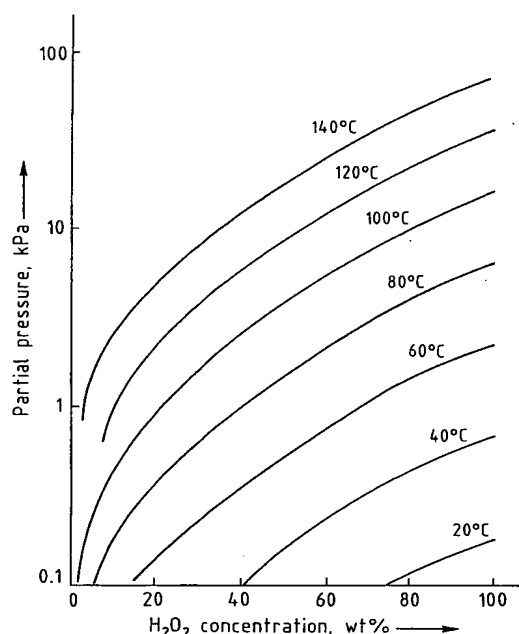


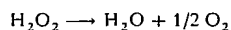
Figure 2. Partial pressure of hydrogen peroxide over aqueous hydrogen peroxide solutions

3. Chemical Properties

Dissociation. Hydrogen peroxide is weakly acidic in aqueous solution, with a dissociation constant of 1.78×10^{-12} (pK 11.75) at 20°C. As a weak acid, hydrogen peroxide forms salts with various metals.

Oxidation and Reduction. Hydrogen peroxide can behave both as an oxidizing and as a reducing agent (Tables 3 and 4). Systems with a redox potential $E_0 < -1.80$ V at pH 0 cannot be oxidized by hydrogen peroxide; systems with a redox potential $E_0 > -0.66$ V at this pH cannot be reduced by hydrogen peroxide [6], [20].

Decomposition of hydrogen peroxide occurs with disproportionation



and is extremely important in handling hydrogen peroxide during storage and in the laboratory. This reaction is highly exothermic (see Chap. 2) and takes place in the presence of small amounts of catalyst even in aqueous solution. In the ab-

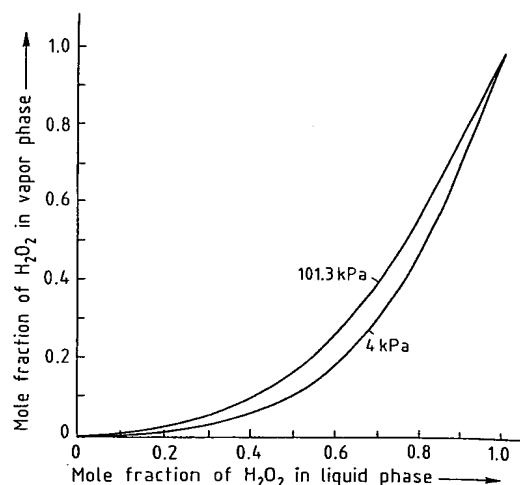


Figure 3. Vapor-liquid equilibrium curve for water-hydrogen peroxide

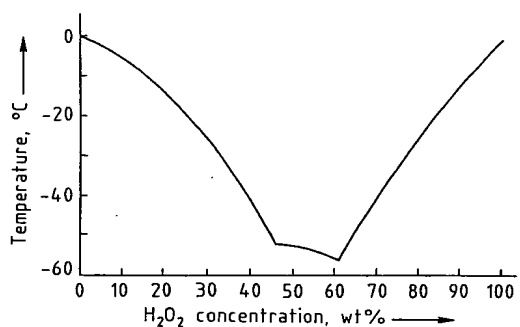


Figure 4. Freezing point curve for water-hydrogen peroxide

Table 3. Hydrogen peroxide as an oxidizing agent [20]

Redox reaction	Standard potential E_0 , V*
pH 0	
$HOOH + 2 H^+ + 2 e^- \rightarrow 2 HOH$	+1.80
$HSO_3^- + HOH \rightarrow SO_3^{2-} + 3 H^+ + 2 e^-$	-0.17
$NO_2^- + HOH \rightarrow NO_3^- + 2 H^+ + 2 e^-$	-0.94
$2 Cl^- \rightarrow Cl_2 + 2 e^-$	-1.36
$2 Br^- \rightarrow Br_2 + 2 e^-$	-1.07
$2 I^- \rightarrow I_2 + 2 e^-$	-0.54
pH 14	
$HOOH + 2 e^- \rightarrow 2 OH^-$	+0.87
$Mn(OH)_2 + 2 OH^- \rightarrow MnO(OH)_2 + HOH + 2 e^-$	+0.05

* Standard potential of redox reactions measured against a hydrogen electrode (25°C, 100 kPa).

Table 4. Hydrogen peroxide as a reducing agent [20]

Redox reaction	Standard potential E_0 , V*
pH 0	
$\text{HOOH} \rightarrow 2\text{H}^+ + \text{O}_2 + 2\text{e}^-$	-0.66
$5\text{e}^- + \text{MnO}_4^- + 8\text{H}^+ \rightarrow \text{Mn}^{2+} + 4\text{HOH}$	+1.51
$1\text{e}^- + \text{Ce}^{4+} \rightarrow \text{Ce}^{3+}$	+1.61
pH 14	
$\text{HOOH} + 2\text{OH}^- \rightarrow 2\text{HOH} + \text{O}_2 + 2\text{e}^-$	+0.08
$1\text{e}^- + \text{ClO}_2^- \rightarrow \text{ClO}_2$	+1.16
$2\text{e}^- + \text{ClO}^- + \text{HOH} \rightarrow \text{Cl}^- + 2\text{OH}^-$	+0.89

* Standard potential of redox reactions measured against a hydrogen electrode (25 °C, 100 kPa).

sence of catalyst, it occurs only in the gas phase at high temperature.

Decomposition can be catalyzed both homogeneously by dissolved ions (especially of the heavy metals iron, copper, manganese, and chromium) and heterogeneously by suspended oxides and hydroxides (e.g., manganese, iron, copper, palladium, or mercury) and by metals such as platinum, osmium, and silver.

Substitution. The hydrogen atoms of hydrogen peroxide can be substituted by alkyl and acyl groups, leading to the formation of

$\text{H}-\text{O}-\text{O}-\text{alkyl}$	alkyl hydroperoxides
$\text{alkyl}-\text{O}-\text{O}-\text{alkyl}$	dialkyl peroxides
$\text{H}-\text{O}-\text{O}-\text{acyl}$	percarboxylic acids
$\text{acyl}-\text{O}-\text{O}-\text{acyl}$	diacyl peroxides

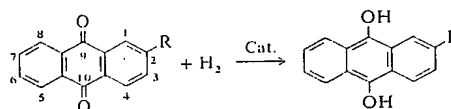
Hydrogen peroxide forms peroxohydrates with a number of compounds. Addition compounds with sodium carbonate (sodium carbonateperoxohydrate [15630-89-4]) and with urea (urea peroxohydrate [124-43-6]) are industrially important. For a detailed description of peroxo compounds see → Peroxo Compounds, Inorganic; → Peroxy Compounds, Organic.

4. Production

4.1. Anthraquinone Process (AO Process)

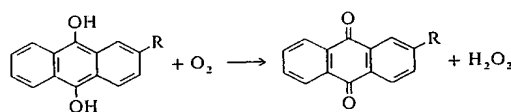
4.1.1. Principles

In the AO process, 2-alkyl-9,10-anthraquinones react with hydrogen in the presence of a catalyst to form the corresponding hydroquinones.



R = alkyl

After the catalyst is removed (otherwise, the hydrogen peroxide would decompose), the hydroquinones are oxidized to quinones with oxygen (usually air) with simultaneous quantitative formation of hydrogen peroxide:



Hydrogen peroxide is extracted with water, and the quinones are returned to the hydrogenator to complete the loop.

The AO process, therefore, leads to the net formation of hydrogen peroxide from gaseous hydrogen and oxygen.

Solvents. Anthraquinones must be dissolved in a suitable solvent for hydrogenation, oxidation, and extraction (the so-called working solution).

Although a number of individual solvents have been proposed (e.g., aromatic alcohols or their esters [21]), solvent mixtures are almost always used because the quinones and hydroquinones formed during the synthesis loop have different solubilities. Quinones dissolve readily in nonpolar, aromatic solvents (quinone solvents). Hydroquinones dissolve well in polar solvents, especially alcohols and esters (hydroquinone solvents). Proposed solvents or solvent mixtures are

Quinone solvents

Benzene [22]
tert-Butylbenzene [23]
tert-Butyltoluene [24]
 Trimethyl benzene [25]
 Polyalkylated benzenes [26]
 Methylnaphthalene [27]

Hydroquinone solvents

Alkyl phosphates [28]
 Alkyl phosphonates [29]
 Nonyl alcohols [27]
 Alkylcyclohexanol esters [30]
N,N-Dialkyl carbonamides [31]
 Tetraalkyl ureas [32]
N-Alkyl-2-pyrrolidones [33]

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